Regenerative Gas Dryer for Integrated ISRU Systems

Completed Technology Project (2015 - 2016)

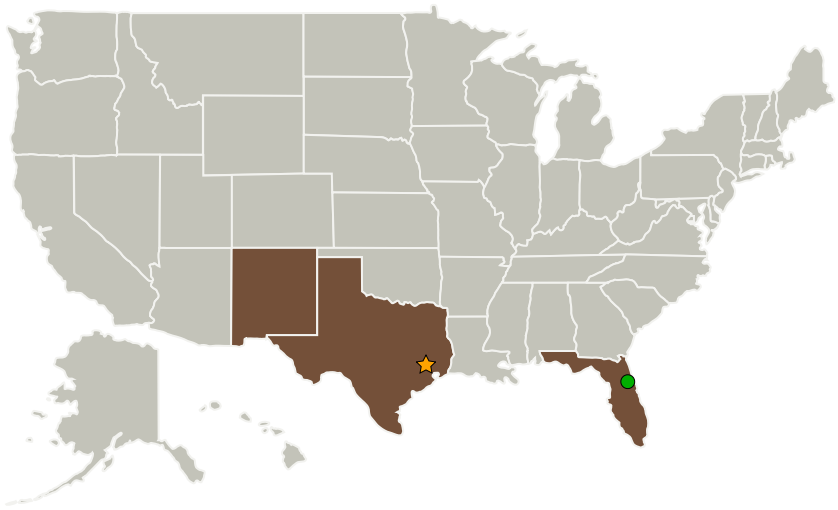
Project Introduction

Rocket propellant can be produced anywhere that water is found by splitting it into hydrogen and oxygen, potentially saving several tons of mass per mission and enabling the long term presence of humans in space beyond LEO. When water is split into hydrogen and oxygen, the gaseous products can be very humid (several thousand ppm). Propellant-grade gases need to be extremely dry before being converted into cryogenic liquids. The primary objective of this project is to design, build and test a regenerative gas drying system that can take humid gas from a water electrolysis system and provide dry gas to the inlet of a liquefaction system for long durations. State of the art work in this area attempted to use vacuum as a means to regenerate desiccant, but it was observed that water would migrate to the dry zone without a sweep gas present to direct the desorbed vapor. Further work attempted to use CO2 as a sweep gas, but this resulted in a corrosive carbonic acid. In order for in-situ propellant production to work, we need a way to continuously dry humid gas that addresses these issues.

Anticipated Benefits

The objective of this effort is to design, build, test and evaluate a method of gas drying that can be used for in-situ propellant production. Test data from this project will be used in models to help predict the total mass, power, and volumes associated with various ISRU applications and architectures. The final product will be a fully functional system that will be integrated into an end-to-end ISRU propellant production demonstration.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Florida	New Mexico
Texas	

Project Transitions

October 2015: Project Start

September 2016: Closed out

Closeout Summary: Testing of the canister design verified that the product gas was below the dryness required (26 ppmv) after 4 hours of continuous use. The canister was designed to operate on a 4 hour regeneration cycle. Visual observation of the desiccant (indicating drierite) after 4 hours shows that approximately half of the desiccant became saturated. After four hours of operation, the water content at the outlet of the canister was 15 ppmv. This test validated the design of the canister, where the residence time of the gas is a function of the canister diameter.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

Aaron Paz

Principal Investigator:

Aaron Paz

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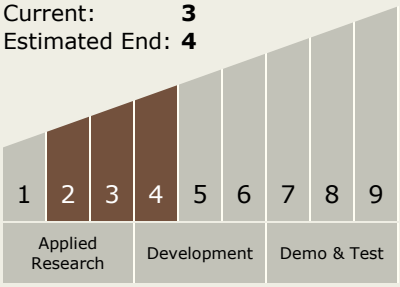
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Moon, Mars

Supported Mission Type

Projected Mission (Pull)